INDUSTRIAL DISEASES AND OCCUPATIONAL HAZARDS IN FERRO ALLOY INDUSTRY

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INTRODUCTION

Industrial medicine is a science and art of preserving health through the recognition, evaluation and control of environmental causes and sources of illness in industry.

OBJECTIVE

Industrial medicine resolves itself into the problem of finding factors or conditions in work places that may cause or contribute to the illness of the employee and of devising methods of eliminating or controlling such conditions.

AGENCIES SHAPING INDUSTRIAL HEALTH

The agencies at international and national level involved in policy making with regard to industrial hygiene are:

1) International labour organisation
2) W.H.O.
3) Labour Ministry
4) Health Ministry
5) All India Institute of Hygiene & Public Health

ROLE OF A MEDICAL OFFICER IN AN INDUSTRY

I. The Medical Officer working in an industry should have a working knowledge of:
   a) the nature of work in which the workers are engaged
   b) the Etiological causes associated with the disease found in that particular industry industry

   c) the industrial processes used in the industry and be proficient in the

   a) Assessment of hazards and their effects
   b) Treatment of hazards
   c) Prevention of hazards

II Periodic Reexamination - Frequency and extent of examination depends upon the occupation.

III Frequent Plant Survey - Plant housekeeping, requires constant vigilance over the safety programme, the efficiency of protective procedures such as ventilation and certain individual equipment as well as secure functioning, exhausts with special precaution against potential fire hazards.

IV Educational and Training Programmes - Education on nutrition and health matters - Training in first aid etc.

V Curative Work

FACTORS ADVERSELY AFFECTING THE WORKERS

Factors adversely affecting the worker can be broadly classified into four groups -

1) Physical factors in the environment - Light, heat, humidity, noise vibration etc
2) Chemical factors in the environment - gases, solids, liquids, dust, fumes
3) Biological factors
4) Mechanical factors - Accidents

PHYSICAL FACTORS IN THE ENVIRONMENT ADVERSELY AFFECTING THE WORKER

The commonly associated diseases due to heat and humidity in the environment are classified below:

A	Skin disorders	-	Sun burns, prickly heat
B	Circulatory disorders	-	Heat syncope
C	Disorders of salt and cramps	-	Heat exhaustion, heat water metabolism
D	Failure of heat regulation	-	Heat stroke

DISEASES ASSOCIATED WITH HEAT AND HUMIDITY
ALONGWITH THEIR SIGNS AND SYMPTOMS

	Heat Exhaustion	Heat Cramps	Heat stroke
1. Skin	Pale, sweating	Moist and cool	Dry
2. Temperature	Slightly raised	Normal or slightly raised	Highly raised as high as $106^{o}F$
3. Pulse	Rapid	Rapid	Rapid & full
4. Blood pressure	Lying pressure normal. Diastolic pressure always raised	Normal	Elevated
5. Signs and symptoms	Vomiting and crams occur from time to time.	Cramps in muscles in active use. Headache, twitching	Flushing of the the face and conjunctive with excitability, frequency of urine unconsciousness. Even after gaining consciousness, nervous symptoms such as ocular palsy persists

It may be noted that exhaustive heat is not conducive to persons having had malaria, Hypertension, Heart diseases, skin diseases, the aged and the markedly obese.

II CHEMICAL FACTORS IN THE ENVIRONMENT ADVERSELY AFFECTING THE WORKER - (1) GASES

The effects of two important gases, i.e. carbon monoxide, and sulfur dioxide are discussed as follows:

CARBON MONOXIDE

There is a danger from CO in all places where combustion goes on, as such it is a universal hazard. It is a colourless and odourless gas, which makes it very dangerous as its presence is not detectable. Early symptoms of carbon monoxide poisoning are so mild that the workers often ignore them.

The general changes resulting from carbon monoxide poisoning may first present

as cherry red blotching in various areas of the body. There may be hemorrhages in the lungs, pericardial, gastro intestinal tract and under mucous membranes. It may also cause great injury to the nervous system and the blood vessels in the brain, with raised intracranial pressure.

The signs and symptoms of carbon monoxide poisoning may be well depicted by the various percentage of carboxyhaemoglobin in the blood.

Acute Effects	Blood Saturation, % CO Haemoglobin	Symptoms
	0-10	No symptoms
	10-20	Tightness across forehead, possibly slight headache, dilation of cutaneous blood vessels.
	20-30	Severe headache and throbbing in the temples.
	30-40	Severe headache, weakness, dimness of vision, nausea, vomiting and collapse.
	40-50	Same as previous item with more possibility of collapse and syncope and increased respiration and pulse.
	50-60	Syncope, increased respiration and pulse, coma with intermit- tant convulsions.
	60-70	Coma and intermittent convuls- ions, depressed heart action and respiration and possible death.
	70-80	Weak pulse and slow respirat- ion, respiratory failure and death.

Cases of severe carbon monoxide poisoning are usually dueto accidental leakage of large quantities of CO. Symptoms depend on the concentration of gas, activity or inactivity of the patient and individual susceptibility. At a concentration of 40-50%, the effects become dangerous because muscular weakness overcomes the worker and the worker is not in a position to leave the place even if he wants to do so. As such he collapses and has to be rescued. To a man who is vigorously active, even a concentration of 50% may prove far more dangerous than a man who is at rest and may survive 80% concentration.

CHRONIC EFFECTS

Well known effects of prolonged exposure to carbon monoxide are no different from acute effects. Headache, nausea, impaired senses, general debility, vertigo are commonly seen. Where poisoning is severe enough to cause unconsciousness however, some damage to the brain, central nervous system and circulation may occur related in degree to the length and severity of the asphyxia.

RELATION BETWEEN CONCENTRATION OF CO IN AIR AND THE EFFECTS

% of CO	ppm	Effects
0.01	100	Effects imperceptible in 8 hours exposure.
0.02	200	Mild headache after 2-3 hours.
0.04	400	Frontal headache after 1-2 hours. Occipital headache after $2^{1}/_{2}$-$3^{1}/_{2}$ ho
0.08	800	Severe headache, nausea, dizziness after 3/4th hour.
0.16	1600	Headache, nausea, dizziness in 20 minutes. Collapse, unconsciousness a probably death in 2 hours exposure.
0.32	3200	Headache, dizziness, nausea in 5 minutes. Death in 30 minutes.
0.64	6400	All above effects in 1-2 minutes exposure and death in 15 minutes exposure.
1.28	12800	Death in 1-2 minutes.

There are several ways of detecting carbon monoxide in the environment.

1. Use of Canary Birds

Effects of carbon monoxide is proportional to the body weight. Effect on the canary birds is very rapid. 0.02% in a man will produce no effect, but will have an adverse effect on the bird, they become restless, even unconscious. This is a qualitative test.

2. Quantitative Method

a) Laboratory methods - too time consuming
b) Field method - most useful based on the reaction of CO and palladium chloride.

Palladium chloride is colourless or just pink. The kit contains ampoules of 1% solution of palladium chloride in water with a little acetone. Ampoules are covered with cotton and thrown to the site tested at the end of a string and allow to remain there for 10-15 minutes. Due to CO, P,d is liberated and deposits on the cotton. More the CO more of palladium chloride is acted upon and colour ranges from light yellow to black. On the chart are plotted concentration of CO.

Check on Workers

There are several methods of detecting CO in blood:

1) Take 2-3 cc of blood and boil it.
No CO - blood becomes brown.
CO present - cherry red.

2) Take 2 cc of blood, dilute with 2 cc of water and add 3-4 drops of 1/3 saturated $CuSO_4$ ------- boil
Normal blood - greenish brown ppt.
CO present - Cherry red or brown red ppt.

Treatment

Remove from the area of exposure and restore breathing. Do not treat on the spot. Carry the patient to fresh air. Do not allow to walk. Administer O_2, CO_2 (5-7%). Sometimes pure oxygen at a pressure of 30 lbs. Continue oxygen for 15 minutes, avoid exposure to cold. Wrap in blankets. Precautions against pneumonia should be taken.

SULPHUR DIOXIDE

Sulphur dioxide is found wherever sulphur is burned in the air. It is an irritant gas. It is one of the most prominent gases contributing to atmospheric pollution in large cities and areas surrounding smelters. In moist air it combines to form sulphurous acid and is slowly oxidized to sulphuric acid.

Physical and Chemical Properties

Colourless, irritant gas, having a characteristic odor and taste.
Molecular weight - 64.07

Sp. gravity - 1.434

Melting point - 72.7°C

Effects on the human body

Acute Effects - Irritation of the eyes, nose and the throat. It is so irritating that man usually withdraws before further damage is done. Failing, in some circumstances, man develops oedema of the lungs, and respiratory failure due to paralysis of the respiratory centre.

Chronic Effects - Chronic catarrh, nasopharngitis, disturbances of smell and taste, increasing lassitude and fatigue.

Maximum permissible concentration - 5 ppm for prolonged exposure.
50-100 ppm for 30-60 mts exposure
400-500 ppm - immediately dangerous to life.

Treatment

Eyes - Copious, lavaging of the eyes with water

Protect the eyes with gas mask.

Respiratory Disturbances

Artificial respiration, respiratory stimulants, O_2 - and 5-7% CO_2 in severe cases, bed rest, soothing cough syrups. Apply bland oil to all exposed mucous membranes.

II DUST

The dust associated diseases can be categorised according to its effects it produces on the lungs such as:

i) Inert dust - Coal, limestone, gypsum.
ii) Fibrosis producing - Free silica containing dust.
iii) Pneumonic dust - Causing consolidation of the lungs - Cd, Mn, Beriphylium.

iv) Producing toxic reactions - Fever producing - Metal fumes.

Dusts are generated in different industrial processes and fall under the term aerosol i.e. suspension of particulate matter in the air. Four types of aerosols

have been described:

i) Dust
ii) Fumes
iii) Smoke
iv) Mist

Dusts are generated by breaking of solid materials. The size varies between 0.5 - 100 u. Do not flocculate.

Fumes are solid particulate suspension but generated by condensation of vapour, mostly metals less than 1.0 u in size. Tend to flocculate.

Smoke due to incomplete combustion of carbonaceous material and suspension of very fine particles of coal in air less than 1.0 m size.

Mist Suspension of liquids in air due to spraying or churning etc.

DISEASES ASSOCIATED WITH DUSTS: are

i) SILICOSIS
ii) MANGANESE POISON

SILICOSIS

A disease due to breathing of air containing silica (SiO_2). Clinically characterised by shortness of breath, decreased chest expansion, lessened capacity to work, absence of fever with increased susceptibility to tuberculosis. This disease is becoming rare as the standard of industrial hygiene is very much on the improve.

DURATION OF EXPOSURE IN FERRO-SILICON OPERATORS - 10-15 years.

SYMPTOMS

- Shortness of breath is the most common symptom.
- Cough - unproductive cough is more pronounced towards morning.

- Chest pain - which may be reterosternal accompanied with tightness around the chest.
- Dizziness caused by effort-brought on by difficulty in breathing
- Fatigue and weakness.
- Rarely sputum may be tinged with blood.
- Features of right sided heart failure.

INVESTIGATIONS - X-RAY CHEST

Extensive fibrosis with 'Egg shell' calcification of Hilar lumph nodes.

FLUOROSCOPY - will show diminished diaphragmatic movements.

M.A.C. 5 million particles/cubic feet fir dysts cibtaububg 50% silica or more.
20 million particles/cubic feet for 5 - 50% silica.
50 million particles/cubic feet for less than 5% silica.

TREATMENT

1) Antispasmodic aerosol
2) Antitubercular treatment

MANGANESE POISONING

Cases of manganese poisoning are few because
i) All people are not susceptible to Mn poisoning.
ii) It requires a very heavy and consistent exposure to produce any effect.
iii) All compounds of Mn are not toxic, only MnO_2 is toxic.

It takes about two years exposure for any symptoms to appear. Effects of Mn are essentially on the central nervous system. It is absorbed through dust in air, excreted in the urine and faces.

SYMPTOMS

- Twitching and stiffening of muscles are first noticed.
- Twitching starts with the facial muscles
- Langour and sleeplessness
- Unaccountable laughter
- Mask like expression
- General clumsiness of movement
- Topples over with little push

- Altered gait (Hens gait)
- Speech disturbances with slow and difficult articulation
- Incoherence with complete muteness may also occur

Despite of severe incapacitation by the disease, the patient survives though permanently disabled unless treated. Factors influencing sensitivity are alcoholism, chronic infection and liver dysfunction.

Many of the symptoms disappear if the worker is removed from the exposure though there may be some residual effects in speech and gait.

M.A.C. 60 mg/cub. meter.

3. METAL FUMES

Metal fume fever also known as Brass Chill, Zinc Chills, Spleter's shake is characterised by Malaria like fever with onset some hours after the exposure to metal fumes. Workers are more susceptible on Mondays and week days following a holiday.

Symptoms

- Chills with fever - rarely exceeds $102^{o}C$
- Nausea, Vomiting
- Dryness of throat
- Cough
- Body aches
- Lassitude
- Headache

After a few hours, the victim sweats profusely and the temperature begins to fall. The condition lasts for a day. Mental confusion and convulsion may be present.

Blood Picture

W.B.C. count 12000 - 16000 per cu. mm
Occasionally glucose is found.

Treatment

Aspirin gr X - thrice daily
Plenty of fluids.

The biological and mechanical factors in the environment adversely affecting the workers will be dealt with separately.

CONCLUSION

Improved standards of engineering along with the application of proper safety devices can to a very great extent minimise these hazards if not totally eradicate them

References

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